SBP Working Paper Series

No. 17 June, 2007

Estimating Quarterly Gross Fixed Capital Formation

Muhammad Farooq Arby
Irem Batool

STATE BANK OF PAKISTAN

SBP Working Paper Series

Editor: Riaz Riazuddin

The objective of the SBP Working Paper Series is to stimulate and generate discussions, on different aspects of macroeconomic issues, among the staff members of the State Bank of Pakistan. Papers published in this series are subject to intense internal review process. The views expressed in the paper are those of the author(s) and do not necessarily reflect those of the State Bank of Pakistan.

Price per Working Paper

Pakistan:	Rs 50 (inclusive of postage)
Foreign:	US$ 20 (inclusive of postage)

Purchase orders, accompanied with cheques/drafts drawn in favor of State Bank of Pakistan, should be sent to:

Chief Spokesperson
External Relations Department,
State Bank of Pakistan,
I.I. Chundrigar Road, P.O. Box No. 4456,
Karachi 74000. Pakistan

For all other correspondence:

Editor,
SBP Working Paper Series
Research Department,
State Bank of Pakistan,
I.I. Chundrigar Road, P.O. Box No. 4456,
Karachi 74000. Pakistan

Published by: Editor, SBP Working Paper Series, State Bank of Pakistan, I.I. Chundrigar Road, Karachi, Pakistan.

http://www.sbp.org.pk

Printed at the SBPBSC (Bank) – Printing Press, Karachi, Pakistan

ESTIMATING QUARTERLY GROSS FIXED CAPITAL FORMATION

Muhammad Farooq Arby
Joint Director
Research Department
State Bank of Pakistan
farooq.arby@sbp.org.pk

Irem Batool
Analyst
Monetary Policy Department
State Bank of Pakistan
irem.batool@sbp.org.pk

Acknowledgment

The authors are grateful to Dr. A.R. Kemal for his guidance and valuable suggestions to improve the paper. Suggestions from participants of the seminar in which this paper was presented are also acknowledged. For any errors remaining in the paper, the authors are solely responsible.

Contact for correspondence

Irem Batool
Monetary Policy Department, State Bank of Pakistan
I.I. Chundrigar Road, Karachi, Pakistan
irem.batool@sbp.org.pk
Ph: +92 21 2453881

Abstract

In Pakistan, only annual estimates of national accounts are available officially. Although quarterly real gross domestic product has been estimated by some studies like Kemal & Arby (2004) and Bengaliwala (1995), no attempt has been made so far to estimate quarterly gross fixed capital formation – a key macroeconomic variable. This study presents a methodology to quarterise gross fixed investment in Pakistan and estimates a quarterly series for the period 1971Q3 to 2006Q2. Using the commodity flow approach, total gross fixed investment has been disaggregated into four components, i.e. machinery and equipment, furniture and fixture, structure and land improvement for annual data of selected years and then each component is quarterised on the basis of related indicators for which quarterly data is available officially.

Key Words: National Income Accounts, Gross Fixed Capital Formation, Commodity flow approach, Pakistan

JEL classification: E22; C82

Estimating Quarterly Gross Fixed Capital Formation

The official estimates of national accounts in Pakistan are available only on annual basis. The lack of higher frequency data on key macroeconomic variables has been a stumbling block to a meaningful economic research, particularly econometric modeling where the length of time series has a bearing on the quality of models. Although Bengaliwala (1995) and Kemal and Arby (2004) have estimated quarterly real GDP along with its sub-sectors on the supply side, i.e. agriculture, industry and services, the quarterly national accounts in expenditure side are still unavailable. This study attempts to quarterise the annual data of gross fixed capital formation (GFCF) – the only variable needed to present a complete table of quarterly national accounts with broad aggregates on the expenditure side.[1]

The gross fixed capital formation can be estimated through three approaches: commodity flow, expenditure and financing approach. We adopted the commodity flow approach where capital goods flow into the economy from different sources. There are four types of capital goods included in gross fixed capital formation, viz. machinery and equipment, furniture & fixture, structure, and land improvement and cultivated assets in livestock sector and orchard plantation. The machinery and equipment enter into the economy through two sources viz., domestic production and imports; structure includes construction work undertaken in the domestic economy; and land improvement and cultivated assets are also domestic activities. We estimated the quarterly series of capital

[1] As overall quarterly GDP is already available in Kemal and Arby (2004) and quarterly net exports are also available officially, the availability of investment series would be sufficient to make a complete table of national accounts in expenditure side by computing quarterly consumption as residual.

formation on the basis of these components. The rest of the paper consists of a section on methodology and another section on results. The last section concludes the paper.

2. Methodology

As already mentioned, the gross fixed capital formation can be expressed as a sum of the four components, i.e. $I_t = M_t + S_t + R_t + L_t$ with $M_t = MF_t + MD_t$. The I_t is aggregate gross fixed capital formation, M_t is total machinery and equipment, S_t is structure, R_t is furniture & fixture and L_t is land improvement including improvement of water courses, and cultivated assets in the livestock sector.[2] The M_t consists of domestically produced machinery (MD_t) and imported machinery & equipment (MF_t).

In the first step of estimating quarterly investment, we disaggregated the total investment into its five components for some selected years for which detailed information was available. The second step is to quarterise the annual values of these five components by using some indicators of which quarterly data is available in official sources as given in Table 1. In the next step, quarterly values of these components are estimated for the remaining years through interpolation which is done on the basis of annual compound growth rates.

The total gross fixed investment is then worked out by aggregating the quarterly values of its components. The gross fixed investment is estimated both at current and constant prices. Different deflators are used to convert the values of components of fixed

[2] Cultivated assets in orchard plantation are ignored due to their very insignificant amount (see Arshad Zaman Associates, 2002, p23).

investment at current prices to constant prices of 1999-00: unit value index is used for imported machinery and equipment, WPI manufacturing is used for domestically manufactured machinery and equipment, WPI building material is used for structure, and WPI food for land improvement.

Table 1: Indicators for Estimating Quarterly Components of GFCF

	Indicator	Data Source
a) Imported Capital	No other indicator is needed as quarterly data of this component is available	Monthly Statistical Bulletin, FBS
b) Domestic Capital		
i) Machinery & Equipment	Quarterly LSM Machinery & equipment sub-index*	Monthly Statistical Bulletin, FBS
ii) Furniture & Fixture	Fixed rate of 5 percent of Structure	Estimated by authors (see Table 2)
iii) Land improvement[#]	Quarterly value added of Crops (with two quarters lead) [$]	Kemal & Arby (2004)
iv) Structure	Quarterly LSM Building material sub-index*	Monthly Statistical Bulletin, FBS

* Estimated by authors by using quarterly production of relevant items and their relative weights information for which are available in FBS Monthly Statistical Bulletin.
# The cultivated assets are distributed equally into four quarters following Kemal & Arby (2004) wherein except milk all other components of the livestock are distributed into four quarters equally.
$ In Pakistan, there are two major types of crops (a) Kharif crops with sowing seasons in April-June and harvest season in October-December, (b) Rabi crops with sowing season in October-December and harvest season in April-May. Since crops' value addition belongs to harvest season while investment activity is undertaken during sowing season. Therefore, we have taken crops value added with two quarters lead as an indicator of land improvements.

An attempt is also made to use the newly estimated real investment series in examining the linkage between investment and growth. For this purpose Granger causality test[3] is applied on quarterly real investment growth estimated by this study and quarterly real GDP growth estimated by Kemal and Arby (2004).

[3] Before applying the Granger causality test, we applied seasonal unit root test on quarterly real GDP and real GFCF series. It is found that real GDP has two unit roots, one at zero frequency and the other at bi-annual; while real GFCF has only one unit root at zero frequency. Both the series are made stationary by appropriate differencing.

The component of imported machinery and equipment (MF_t) is obtained from the monthly Statistical Bulletin of the Federal Bureau of Statistics (various issues) which gives both annual and quarterly data of imports by commodity groups. The domestic production of capital goods is obtained from various censuses of manufacturing industries (CMIs) and censuses of small and household manufacturing industries (SHMI).[4] Productions of furniture & fixtures, both metal and non-metal, are also taken from CMI and SHMI.[5] The value of land improvement is worked out as 15.2 percent of gross fixed capital formation in the agriculture sector.[6] The cultivated assets are taken as 4 percent of total value added of livestock worked out on the basis of information given in FBS (2004). With the estimates of four components in hand, we worked out the last component, structure (S_t) as residual. The annual numbers of gross fixed capital formation are taken from the series generated by Ayaz (2006). This process of disaggregation is carried out for the years 1975-76, 1980-81, 1985-86, 1990-91 and 2000-01.[7]

3. Results

The shares of the five components of the total gross fixed investment as a result of the decomposition exercise are reported in Table 2. It comes out that imported capital contributes about a quarter of the gross fixed investment while another quarter is domestically produced machinery and equipment. On the other hand, structure constitutes

[4] Both published by Federal Bureau of Statistics for selected years.
[5] The SHMI is not undertaken by the Federal Bureau of Statistics in regular interval; therefore, in order to make the relevant figures of CMI and SHMI comparable for a given year, we adjusted the SHMI (1996-97) data with growth rate of small-scale manufacturing value added.
[6] We used the ratio as given in Agriculture Census 1990 according to which land improvement is 14.1 percent and water course improvement is 1.1 percent of the total fixed investment.
[7] No census of manufacturing was undertaken in the mid 1990s.

around 45% of the total gross fixed investment. Our results are close to Arshad Zaman Associates (2002) who worked out shares of structure in total investment as 45 to 49 percent for different years of the late 1990s and that of equipment (domestic and foreign combined) as 42 to 45 percent.

Table 2: Break-up of Gross Fixed Capital Formation (% share)

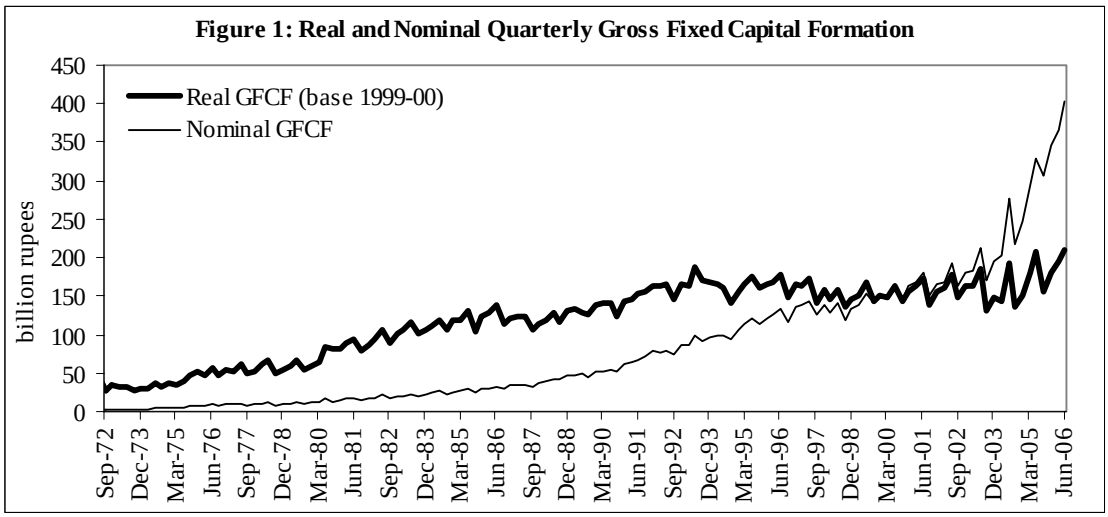
	1975-76	1980-81	1985-86	1990-91	2000-01
a) Imported Capital	23.3	23.9	28.2	23.2	23.8
b) Domestic Capital					
i)Machinery & Equipment *	24.6	23.0	23.2	25.4	26.3
ii)Furniture & Fixture *	0.9	1.1	0.9	1.2	2.3
iii)Land improvement & cultivated assets	4.9	4.4	4.4	4.1	4.3
iv)Structure	46.3	47.6	43.3	46.1	43.3
Total	100.0	100.0	100.0	100.0	100.0

* Production data from CMI is adjusted upward for under-coverage.

The estimated series of gross fixed capital formation at current and constant prices are depicted in Figure 1 (spreadsheets given as annexure). The results show that, on average, 22 percent of the annual gross fixed investment takes place during the first quarter and 28 percent in the last quarter of the fiscal year (July-June). The rest of the annual investment is spread almost equally into the other two quarters (see Table 3).

Table 3: Average Seasonal Factors of Real GFCF

Decades	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun
1970s	0.22	0.25	0.25	0.29
1980s	0.23	0.25	0.26	0.27
1990s	0.23	0.25	0.25	0.27
2000s	0.22	0.24	0.25	0.29
Overall Average	0.22	0.25	0.25	0.28



As regards the relationship between investment and growth, the study finds a two-way causality between the growth rates of the two variables (see Table 4). The real investment growth significantly impacts and is impacted by real GDP growth implying the existence of both the Keynesian investment multiplier and the accelerator principle in case of Pakistan.

Earlier studies on investment and growth relationship include Khan (1996) who finds a significant impact of investment on economic growth from data of 95 countries (including Pakistan) for the 1970-90 periods. Another study by Khan (1988) finds that changes in output have minor impact on private investment while general market conditions have stronger influence on private capital formation in Pakistan.

Table 4: Causal relationship between Real Investment Growth and Real GDP Growth		
Granger Causality Tests; Sample: 1972Q3 2003Q2 Lags: 10*; Obs 120		
Null Hypothesis:	**F-statistic**	**Probability**
Real Investment growth does not Granger Cause Real GDP growth	2.42	0.03
Real GDP growth does not Granger Cause Real Investment growth	3.21	0.01
* Lag length is selected on the basis of sequential modified LR test.		

4. Concluding Remarks

While high frequency data for most of the other macroeconomic variables is available in Pakistan, that for national accounts is not, except for the quarterly series of real GDP and its sub-sectors. This paper, thus attempts to fill the high frequency data gap to some extent by estimating the quarterly gross fixed capital formation for the period 1971Q3 to 2006Q2. We first disaggregated the total fixed investment into its components for annual data of selected years and then estimated quarterly components on the basis of some related indicators for which quarterly information was available. As an application of the newly estimated series, we also examined its relationship with the real GDP growth and found that there existed two-way Granger causality between quarterly real investment growth and quarterly real GDP growth. Future extension to this work can be the quarterisation of investment at sectors level, i.e. gross fixed capital formation in agriculture, industry and services sectors.

References

Agriculture Census Organization (1990), Census of Agriculture 1990; Government of Pakistan, Lahore.

Arshad Zaman Associates (2002,) Capital Formation in Pakistan 1999-00; Federal Bureau of Statistics, Islamabad, September.

Ayaz, Adila (2006), Construction of Consistent Time Series of National Accounts; SBP unpublished manuscript, Economic Analysis Department, State Bank of Pakistan, Karachi.

Bengaliwala, Kaiser (1995), Temporal and Regional Decomposition of National Accounts of Pakistan; Ph.D Dissertation, Department of Economics, University of Karachi.

Federal Bureau of Statistics (2000), Survey of Small and Household Manufacturing Industries 1996-97; Islamabad.

Federal Bureau of Statistics (2002a), Census of Manufacturing Industries (various issues); Islamabad.

Federal Bureau of Statistics (2004), National Income Accounts of Pakistan: Rebasing from 1980-81 to 1999-00; National Accounts Section, FBS, Islamabad.

Kemal, A.R. and M. F. Arby (2004), Quarterisation of Annual GDP of Pakistan; Pakistan Institute of Development Economics, Islamabad, Statistical Papers Series No. 5, December.

Khan, Ashfaque Hasan (1988), Macroeconomic Policy and Private Investment in Pakistan; Pakistan Development Review, 27, 277-292.

Khan, Mohsin S. (1996), Government Investment and Economic Growth in the Developing World; Pakistan Development Review, 35, 419–439.

Annexure 1: Real Gross Fixed Capital Formation
(1999-00 prices)
(Rs million)

	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Annual
1971-72	50834	44545	54382	60734	210495
1972-73	40727	44774	44571	56363	186435
1973-74	40890	44301	52959	66594	204745
1974-75	56746	62465	58478	62416	240106
1975-76	69625	78687	73029	85117	306458
1976-77	71384	81392	78301	95336	326413
1977-78	70014	71558	78568	83083	303224
1978-79	57731	66263	69266	79441	272701
1979-80	57956	64583	66138	85115	273793
1980-81	80814	83458	89213	92063	345549
1981-82	82567	88624	91135	102207	364533
1982-83	91014	102817	105561	114909	414301
1983-84	101621	106413	110714	119102	437849
1984-85	104628	116373	118750	133840	473590
1985-86	102880	122322	128240	139005	492447
1986-87	110701	120858	124657	125584	481800
1987-88	101526	113242	120344	131431	466543
1988-89	114696	129847	134729	131689	510961
1989-90	122174	140891	142051	140574	545690
1990-91	122246	144449	148137	153505	568337
1991-92	154482	164296	163137	165914	647830
1992-93	146411	166027	162054	187874	662366
1993-94	171038	168614	164023	159532	663208
1994-95	139304	155584	167078	175972	637937
1995-96	157646	164975	169337	180233	672191
1996-97	151185	166215	162559	171220	651179
1997-98	142255	163125	145506	153871	604757
1998-99	137473	146317	150364	167538	601693
1999-00	145702	152171	148989	160548	607410
2000-01	140536	158250	163158	172480	634424
2001-02	139753	160662	157646	174071	632132
2002-03	146640	164626	160192	186612	658070
2003-04	130247	152684	144979	189821	617731
2004-05	129878	160777	179856	204444	674954
2005-06	171628	188633	187642	196750	744653

Annexure 2: Nominal Gross Fixed Capital Formation

(Rs million)

	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Annual
1971-72	2030	1854	2336	2659	8879
1972-73	2024	2280	2377	2999	9679
1973-74	2301	2694	3351	4644	12990
1974-75	3970	5152	5208	5734	20064
1975-76	6981	7420	7321	8981	30703
1976-77	7669	8821	8489	10341	35320
1977-78	8525	9075	9918	11228	38746
1978-79	8797	10071	10546	12234	41649
1979-80	10687	12182	12705	16212	51786
1980-81	13966	15144	16248	17028	62386
1981-82	15459	17057	17949	20445	70909
1982-83	17259	20286	20707	22928	81180
1983-84	20401	22236	24120	25862	92619
1984-85	22524	25646	26388	30524	105082
1985-86	24278	29560	30815	32976	117628
1986-87	29505	34303	35492	36311	135611
1987-88	32611	36666	38828	42292	150397
1988-89	40284	46377	48308	49188	184157
1989-90	45034	52759	53553	55925	207270
1990-91	50505	62296	63816	66199	242816
1991-92	70843	78794	77449	80183	307270
1992-93	74661	87679	86132	99624	348096
1993-94	91478	95780	98428	98756	384443
1994-95	93422	105764	113490	120442	433118
1995-96	112228	121981	126163	134200	494572
1996-97	115629	137162	137545	142011	532346
1997-98	124553	139841	129337	139400	533131
1998-99	118850	134038	137835	152078	542801
1999-00	141775	151009	150310	164315	607410
2000-01	146023	165866	168751	178686	659326
2001-02	152232	169181	167769	191192	680374
2002-03	162590	183322	182441	208081	736433
2003-04	171869	199820	200172	272974	844836
2004-05	218439	252079	292720	323446	1086684
2005-06	308707	351741	363596	396551	1420595